



22126008

**BIOLOGY  
HIGHER LEVEL  
PAPER 2**

Thursday 17 May 2012 (afternoon)

2 hours 15 minutes

Candidate session number

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Examination code

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**INSTRUCTIONS TO CANDIDATES**

- Write your session number in the boxes above.
- Do not open this examination paper until instructed to do so.
- Section A: answer all questions.
- Section B: answer two questions.
- Write your answers in the boxes provided.
- A calculator is required for this paper.
- The maximum mark for this examination paper is [72 marks].



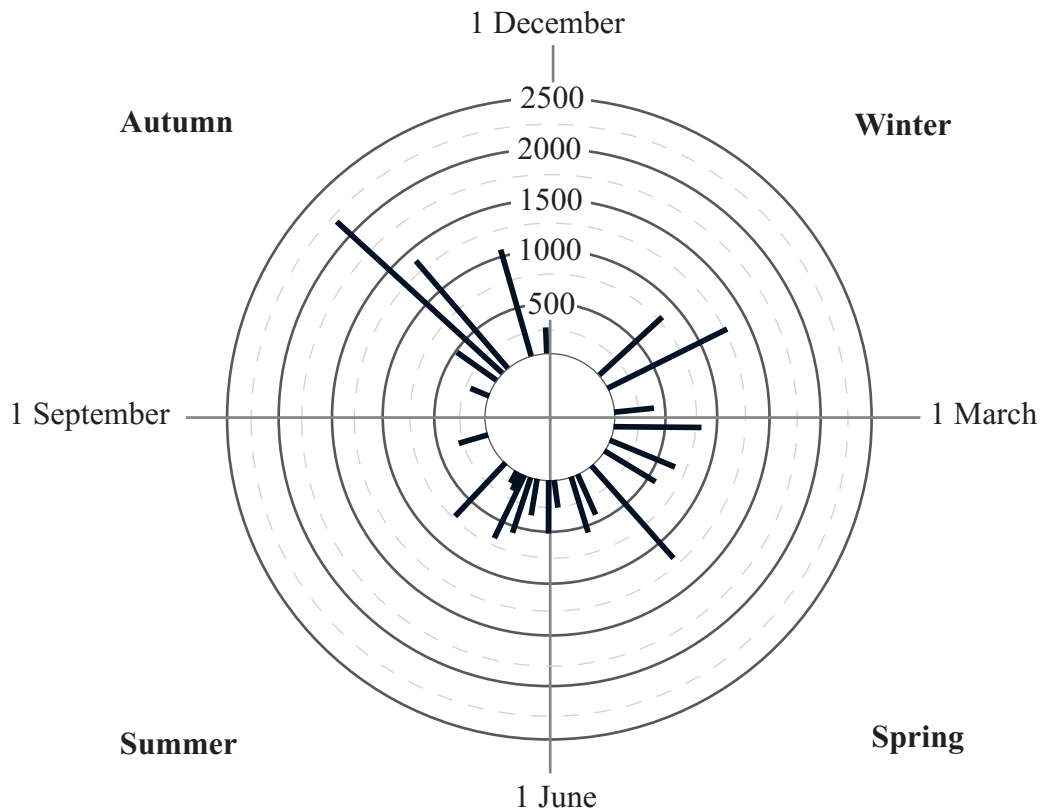
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## SECTION A

Answer **all** questions. Write your answers in the boxes provided.

1. Bottlenose dolphins (*Tursiops truncatus*) inhabit almost all tropical and temperate oceans between 45°N and 45°S. Over a two-year period, aerial surveys were carried out to investigate the seasonal distribution of these animals along the mid-Atlantic and eastern coastal waters of the USA. Sightings were recorded using a global positioning system (GPS) while flying in a regular pattern within approximately 65 km of the shore. A total of 12 760 dolphins were sighted over the two-year period and the data are summarized in the chart below.

Each bar corresponds to a single survey and the length of the bar corresponds to the total number of bottlenose dolphins counted in that survey. The circles with numbers indicate numbers of dolphins.



[Source: adapted from Leigh G. Torres, William A. McLellan, Erin Meagher and D. Ann Pabst (2005)  
 'Seasonal distribution and relative abundance of bottlenosedolphins, *Tursiops truncatus*, along the US mid-Atlantic Coast.'  
*Journal of Cetacean Research and Management*, 7 (2), pp. 153–161.]

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*(Question 1 continued)*

- (a) State the largest number of dolphins counted in a single survey. [1]

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- (b) Calculate the mean number of dolphins counted per survey for the winter season. [1]

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- (c) Compare the data for the dolphin populations in winter and summer. [2]

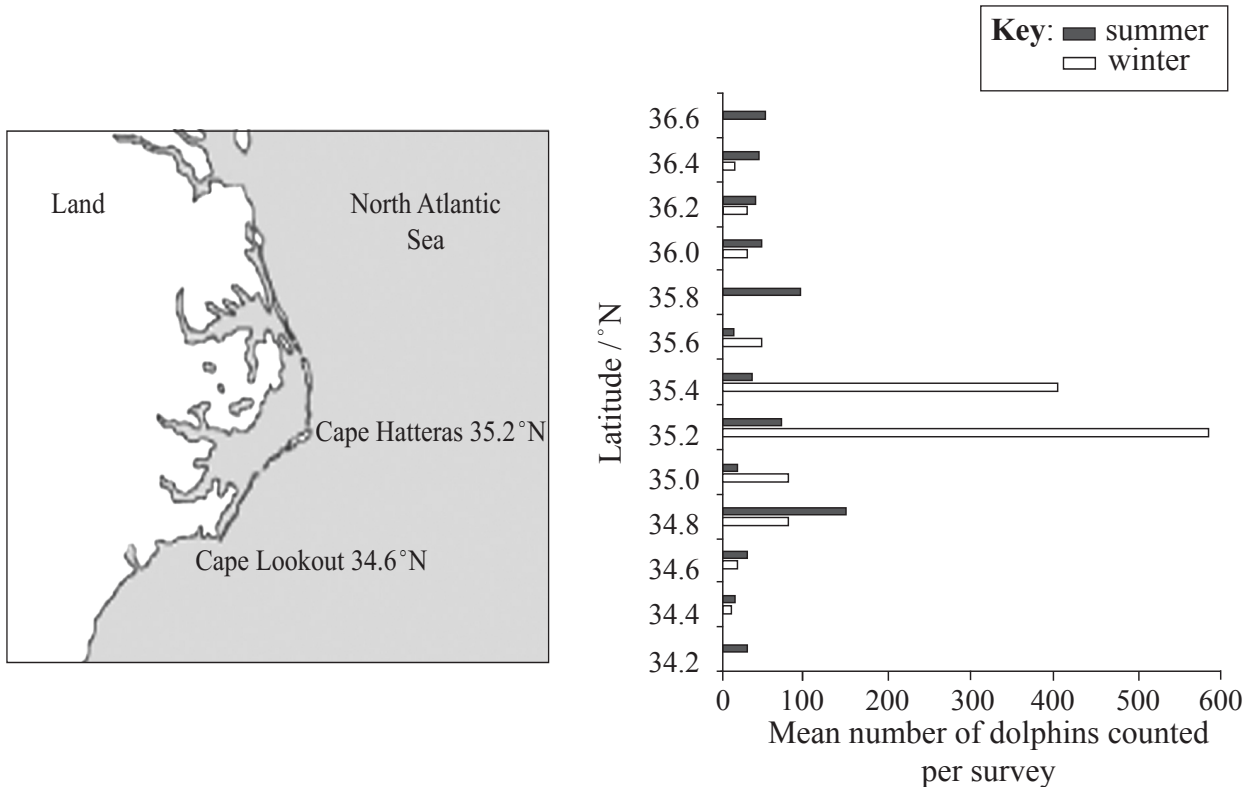
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(Question 1 continued)

As part of the same study, coastal aerial surveys were carried out over the same time period by flying parallel to the coast approximately 500 m offshore. The diagram below shows a map of the section of coast surveyed. The bar graph shows the seasonal data for summer and winter at the corresponding latitudes ( $^{\circ}\text{N}$ ). A total of 5431 bottlenose dolphins were sighted during these surveys.



[Source: adapted from Leigh G. Torres, William A. McLellan, Erin Meagher and D. Ann Pabst (2005) 'Seasonal distribution and relative abundance of bottlenosedolphins, *Tursiops truncatus*, along the US mid-Atlantic Coast.' *Journal of Cetacean Research and Management*, 7 (2), pp. 153–161.]

(d) (i) Compare the distribution of dolphins in summer and winter. [2]

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*(Question 1 continued)*

- (ii) Suggest **one** reason for the differences in distribution.

[1]

<p>.....</p> <p>.....</p>
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Turn over

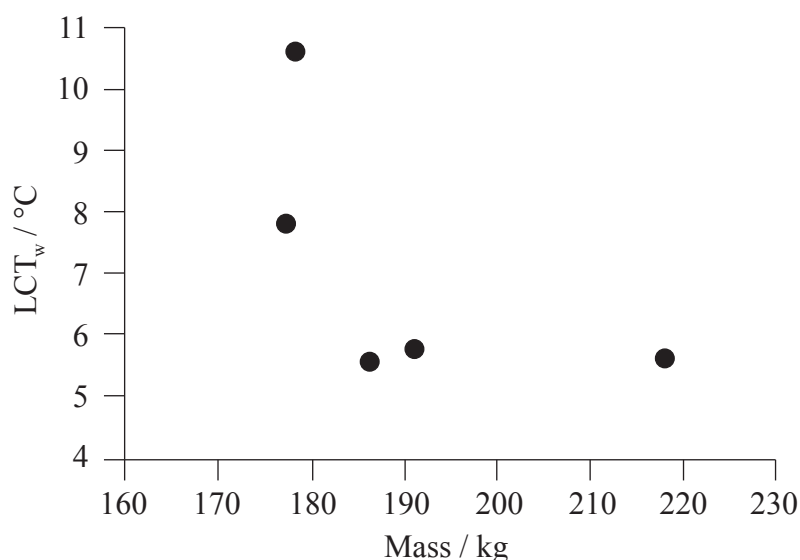
(Question 1 continued)

In a different study, researchers investigated the role of water temperature as a possible factor in the distribution of bottlenose dolphins. The rate of metabolism (measured as the rate of oxygen uptake per unit mass) of five captive adults was measured under a range of water temperatures. The rate of metabolism was found to increase significantly when the water temperature fell below a certain value known as the lowest critical water temperature ( $LCT_w$ ). Below this temperature the body uses more energy to combat the cooling effect of the surrounding water. The data for these animals are summarized below.

Animal	Sex	Age / years	Mass / kg	$LCT_w / ^\circ C$
1	male	27	177.3	7.8
2	male	24	191.4	5.7
3	male	26	219.7	5.6
4	male	14	187.0	5.5
5	female	33	178.2	10.6

Adapted with permission from L.C. Yeates and D.S. Houser (2008) ‘Thermal tolerance in bottlenose dolphins (*Tursiops truncatus*).’ *Journal of Experimental Biology*, 211, pp. 3249–3257, Table 1. doi:10.1242/jeb.020610: The Journal of Experimental Biology: jeb.biologists.org

The graph below summarizes the relationship between  $LCT_w$  and body mass.



[Adapted with permission from L.C. Yeates and D.S. Houser (2008) ‘Thermal tolerance in bottlenose dolphins (*Tursiops truncatus*).’ *Journal of Experimental Biology*, 211, pp. 3249–3257, Figure 4. doi:10.1242/jeb.020610: The Journal of Experimental Biology: jeb.biologists.org.]

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*(Question 1 continued)*

- (e) Outline the relationship between body mass and  $LCT_w$  for male dolphins. [2]

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- (f) Suggest **one** reason for the high  $LCT_w$  measured for the female dolphin. [1]

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- (g) Evaluate the hypothesis that water temperature determines the range and distribution of bottlenose dolphins in the wild. [2]

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*(Question 1 continued)*

- (h) Explain how an increase in water temperature due to global warming could affect the distribution of bottlenose dolphins along the eastern coast of the USA.

[2]

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- (i) Suggest how research into the range and distribution of bottlenose dolphins could benefit from international cooperation.

[1]

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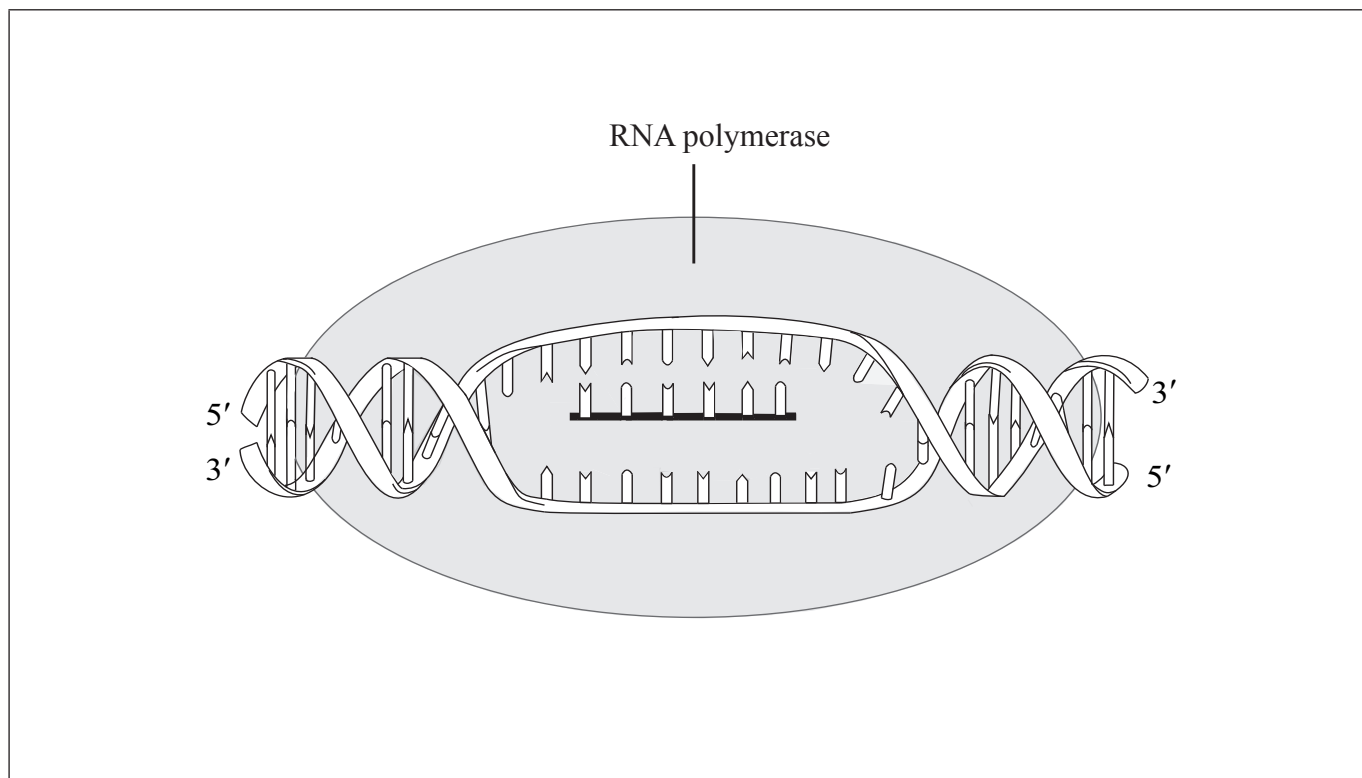
2. (a) DNA replication involves a number of enzymes including DNA polymerase. Identify **one** other enzyme involved in DNA replication. [1]

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- (b) Explain the role of Okazaki fragments in DNA replication. [2]

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- (c) The diagram below shows the process of transcription.



- (i) Label the sense and antisense strands. [1]

- (ii) Draw an arrow on the diagram to show where the next nucleotide will be added to the growing mRNA strand. [1]



3. (a) Outline the mechanisms involved in the control of heartbeat. [3]

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- (b) Explain how the direction of blood flow in the heart is controlled. [2]

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4. (a) Outline the process of *in vitro* fertilization (IVF). [3]

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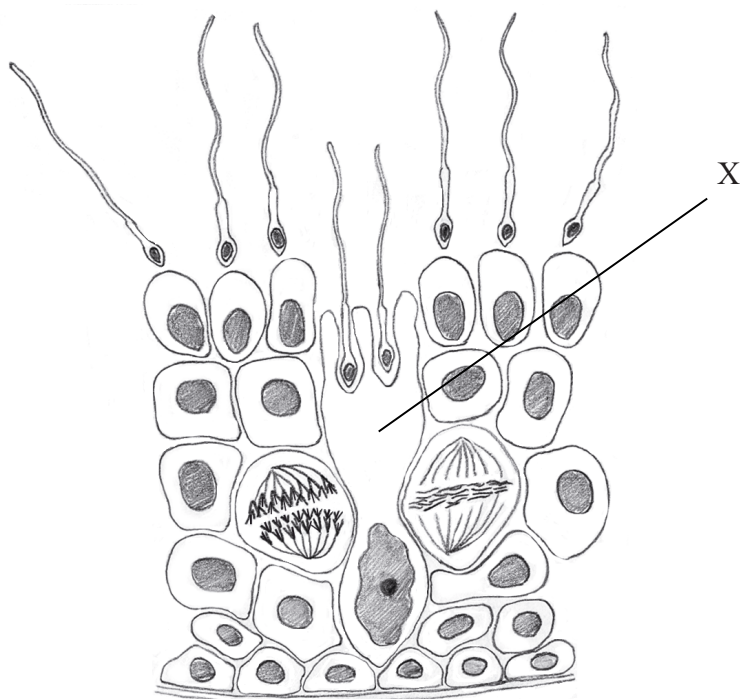
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(Question 4 continued)

- (b) The diagram below shows a small portion of the tissue in a transverse section of a testis.



- (i) Identify the cell labelled X.

[1]

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- (ii) Outline the function of this cell.

[1]

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*(Question 4 continued)*

(c) Explain how meiosis results in genetic variation in gametes.

[2]

<p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p>
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**SECTION B**

*Answer **two** questions. Up to two additional marks are available for the construction of your answers. Write your answers in the boxes provided.*

5. (a) Outline, with examples, the types of carbohydrate found in living organisms. [4]  
(b) Describe the importance of hydrolysis in digestion. [6]  
(c) Explain the effect of inhibitors on the activity of enzymes. [8]
6. (a) Describe the characteristics of stem cells that make them potentially useful in medicine. [5]  
(b) Outline a technique of gene transfer resulting in genetically modified organisms. [5]  
(c) Explain the use of karyotyping in human genetics. [8]
7. (a) Describe how plants carry out gas exchange in the leaves. [5]  
(b) Outline the causes and consequences of the enhanced greenhouse effect. [5]  
(c) Explain the role of limiting factors in photosynthesis. [8]
8. (a) Outline what is meant by homeostasis. [4]  
(b) Describe how body temperature is maintained in humans. [6]  
(c) Explain the processes occurring in the kidney that contribute to osmoregulation. [8]

















